

an optical path may be provided to change a path of second light 521 emitted from a second light source 520 toward an object 580. The optical device may be, for example, a beam splitter 571. When the second light source 520 is used as a laser light source, the second light 521 may be emitted in a very narrow range without a separate optical device like a beam expander. The second light 521, which is emitted toward the object 580 at a certain angle through the beam splitter 571, may be emitted toward a transmission type shutter 530 after being reflected from the object 580. The transmission type shutter 530 may have a 2D structure with a certain area, and the second light 521 may be emitted toward a part of the 2D structure of the transmission type shutter 530, which is disposed near the image sensor 540. Referring to FIG. 5B, the part of the transmission type shutter 530 toward which the second light 521 is emitted may include a center portion C, an upper portion U, a left portion L, a right portion R, and a down portion D. Thus, it is possible to examine transmission uniformity of the transmission type shutter 530 by examining and comparing transmittances of each portion of the transmission type shutter 530 based on the second light 521. The 3D camera 500 according to an exemplary embodiment is able to measure the transmission uniformity of the transmission type shutter 530 by using the second light source 520 without requiring a user of the 3D camera 500 to disassemble the transmission type shutter 530, and thus, may be used as a performance inspection device. Furthermore, a beam splitter 571 may match incident positions of a first light 511 emitted from a first light source 510 and the second light 521 emitted from the second light source 520 so that the first light 511 and the second light 521 are emitted toward the object 580 at the same position. Therefore, it is easy to use the beam splitter 571 when measuring transmittance and transmission uniformity of the transmission type shutter 530 and further measuring a distance between the object and the 3D camera 500 because it is easy to use the 3D camera 500 after measuring the transmittance, as there is no need to additionally adjust a position of the 3D camera 500. In this case, the user only removes a light blocking unit between the beam splitter 571 and the first light source 510 and stops an operation of the second light source 520. The thermal barrier 590 may be substantially the same as the thermal barrier 190.

[0059] FIG. 6 is a schematic view of a 3D camera 600 according to another exemplary embodiment. A beam expander 672 is provided on the front side of the second light source 620 and second light 621 may be widely emitted toward an object 680. The second light 621 reflected from the object 680 may be incident to the entire area of the transmission type shutter 630. The 3D camera 600 according to an exemplary embodiment may obtain a transmittance diagram by measuring an average value of light, which passes through the transmission type shutter 630 and is sensed by an image sensor 640. The image sensor 640 may measure an intensity of light sensed in unit periods as described above. Furthermore, information processing for obtaining a transmittance diagram may be performed by a first controller 701 (of FIG. 7A) which will be described below. The first light source 610 may emit first light 611 in substantially the same fashion as the first light source 110 emits first light 111. Additionally, the beam splitter 671 and thermal barrier 690 may be substantially the same as the beam splitter 571 and thermal barrier 190, respectively.

[0060] FIGS. 7A and 7B are schematic views of a 3D camera 700 according to another exemplary embodiment. Referring to FIG. 7A, the 3D camera 700 according to an exemplary embodiment may include a first light source 710, a first controller 701 controlling an image sensor 740 and a transmission type shutter 730, and a second controller 702 controlling a wavelength and an intensity of the second light 721 emitted by a second light source 720.

[0061] The first controller 701 may demodulate the transmission type shutter 730 and the first light source 710 which emits first light 711 at the same frequency ω towards the object 780. The first controller 701 may apply a reverse bias voltage to the transmission type shutter 730 and may apply an operating current to the first light source 710. The first controller 701 may receive information about a measured intensity of light from the image sensor 740. Furthermore, the first controller 701 may receive information about a wavelength and the intensity of the second light 721 from the second controller 702. The first controller 701 may generate a transmittance diagram of the transmission type shutter 730 by combining the information about a wavelength and an intensity of the second light received from the second controller 702 with the information about a measured intensity of light received from the image sensor 740. The transmittance diagram may be processed in the 3D camera 700 or may be transmitted to the outside. For example, the 3D camera 700 may transceive a signal by being connected to an electronic processor like a personal computer (PC). In detail, the first controller 701 and the electronic processor may be connected to each other. The second controller 702 may be connected to the first controller 701 indirectly via the electronic processor. The connection may be of a wire type or a wireless type. The first controller 701 may include a separate memory device for processing the obtained transmittance diagram. The memory device may be a nonvolatile memory device such as an electrically erasable programmable read-only memory (EEPROM).

[0062] The second controller 702 may control a wavelength and a light emitting operation of the second light source 720 that emits second light 721 and may be electrically connected to the first controller 701. The second controller 702 may adjust the wavelength and the light emitting operation of the second light source 720 according to an electrical signal of the first controller 701. Since the second controller 702 is connected to the first controller 701, wavelength difference information according to a temperature state of the transmission type shutter 730 may be continuously measured by the first controller 701, and thus, a demodulation efficiency of the 3D camera may be increased by adjusting the wavelength and the light emitting operation of the second light source 720. Furthermore, when the light emitting operation of the second light source 720 is not adjusted, a separate spectrometer 760 may be used for measuring the intensity of the second light 721 as described above. Referring to FIG. 7A, the wavelength and the intensity of the second light 721 may be accurately measured as a part of the second light 721 is incident to the spectrometer 760. The first controller 701 may correct the transmittance diagram by receiving information about the measured wavelength and intensity from the spectrometer 760. FIG. 7B is a graph illustrating an intensity of a current according to a wavelength when the second light source 720 operates in a fixed light-emitting mode. Referring to the graph of FIG. 7B, it can be seen that the intensity of a current according to a